IV. Reconciliation of the Test Data

Reconciliation is an accounting of the deterioration of electrical load, heat rate, or thermal efficiency from the decrease in flow and deterioration of turbine section efficiencies. This calculation requires the knowledge of the electrical load produced by each turbine section and the effect of changes in section efficiency on heat rate.

IV. A. Electrical Load Produced By Each Turbine Section

The load produced by each section is equal to the product of the flow through the stages and the used energy across those stages, divided by 3412.1. Using the information from the heat balance shown in Figure 2-9, the shaft output produced by each section as a percent of total kilowatts are:

$$\%KW_{HP} = \frac{w_{HP}\Delta UE_{HP}}{3412.1\ KW_{TOTAL}} = \frac{3{,}948{,}017(1460.4 - 1316.9)}{3412.1(591{,}906)} \times 100 = 28.0\% \qquad (11\text{-}26)$$

$$\%KW_{IP} = \frac{w_{IP}\Delta UE_{IP} - w_{EXT}\Delta UE_{EXT}}{3412.1KW_{TOTAL}} \qquad (11\text{-}27)$$

$$= \frac{3{,}565{,}656(1518.9 - 1386.8) - 142{,}390(1443.2 - 1386.8)}{3412.1 \times 591{,}906} \times 100 = 22.9\%$$

$$\%KW_{LP} = 100 - \%KW_{HP} - \%KW_{IP} = 100 - 28.0 - 22.9 = 49.1\% \qquad (11\text{-}28)$$

Similar calculations for non reheat nuclear units show 35% of the kilowatts are produced in the HP turbine and 65% in the LP turbine. For nuclear reheat units, 31% of the kilowatts are produced in the HP and 69% in the LP. These values vary and should be calculated for each unit being analyzed.

The calculation of the effect on heat rate is slightly more complicated. For the HP turbine, the heat supplied by the boiler must be considered. Also, the IP turbine losses provide more available energy to the LP turbine, requiring the use of a loss factor.

IV. B. Worth of $\Delta\eta_{HP}\%$ in Heat Rate

A change in HP turbine efficiency results in a change in kilowatts produced by that section and a change in reheater duty. These two changes counteract each other. An improved efficiency results in more kilowatts and the lower end point increases reheater duty. The increased kilowatts improve heat rate and increased boiler duty makes the heat rate poorer. The change in heat rate

$$\Delta H.R.\% = \left[\frac{\Delta KW_{HP}}{KW_{TOT}}(100) - \frac{\Delta R}{Bo}\right.$$

The change in reheater duty due to a change in

$$\Delta Reheater\ Duty = \Delta\ Endpo$$

And the change in HP turbine endpoint is:

$$\Delta\ Endpoint_{HP} = AE_{HP}(\eta_{H}$$

$$= \frac{UE(\eta_{HP1} - \eta_{HP2})}{\eta_{HP1}} = U$$

The total boiler duty from the definition of hea

$$Boiler\ Duty_{TOT} = H.R.($$

And the change in kilowatts produced by a cha

$$\Delta KW_{HP} = \frac{\Delta\ Endpoint}{3412.}$$

Substituting Equations 11-31, 11-32, 11-33, and

$$\Delta H.R.\% = \frac{\Delta\eta_{HP}\%(UE_{HP})(w_{HP})}{412\ .1(KW_{TOT})} - $$

3412.1

The percent change in heat rate for a 1% chang

$$\Delta H.R.\% = \frac{(H_T - H_{CRH})\,w_{HP}}{3412.1\,(KW_{TOT})} - \frac{(}{}$$

Using values from the heat balance shown in Fi

$$\Delta H.R.\% =$$

$$\frac{(1460.4 - 1316.9)\ 3{,}948{,}017}{3412.1 \times 591{,}906} - \frac{(1460.4 -}{800}$$

$$= .28 - .11 = .17\%$$

IV. C. Worth of $\Delta\eta_{IP}\%$ in Heat Rate

The worth of a change in IP turbine effi